

CORRECTED VERSION

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
14 December 2000 (14.12.2000)

PCT

(10) International Publication Number  
**WO 00/76087 A1**

(15) International Patent Classification<sup>7</sup>: **H04B 7/185**

(21) International Application Number: **PCT/GB00/02240**

(22) International Filing Date: **8 June 2000 (08.06.2000)**

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
9913351.4 **8 June 1999 (08.06.1999) GB**

(71) Applicant (for all designated States except US): **BAE SYSTEMS ELECTRONICS PLC [GB/GB];** Warwick House, PO Box 87, Farnborough Aerospace Centre, Farnborough, Hampshire GU14 6YU (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **LITTLE, John, Ross [GB/GB];** 8 Great Smials, South Woodham Ferrers, Chelmsford, Essex CM3 5WN (GB). **SEVERWRIGHT,**

**Anthony [GB/GB];** 17 Mapledene Avenue, Hullbridge, Hockley, Essex SS5 6JB (GB).

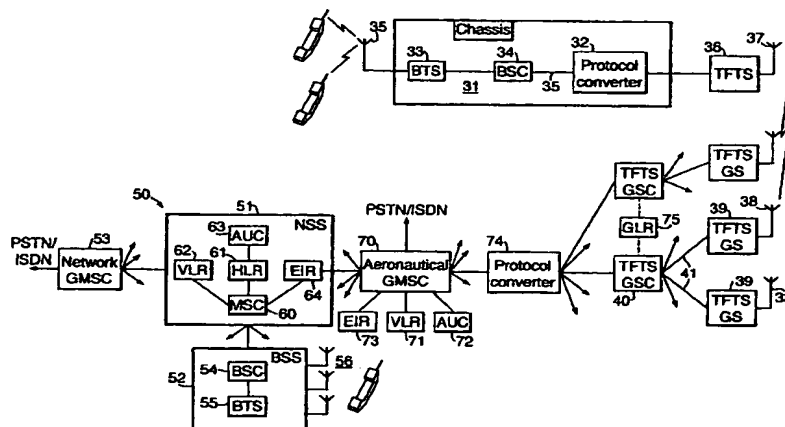
(74) Agents: **EASTMOND, John et al.;** Bae Systems plc/Group Intellectual Property Dept., Lancaster House / PO Box 87, Farnborough Aerospace Center, Farnborough, Hampshire, GU14 6YU (GB).

(81) Designated States (national): **AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.**

(84) Designated States (regional): **ARIPO** patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), **Eurasian** patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), **European** patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), **OAPI** patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: **AIRCRAFT COMMUNICATION ARRANGEMENT DEFINING A RADIO FREQUENCY MICROCELL WITHIN THE AIRCRAFT**



(57) Abstract: In a communications arrangement, apparatus is provided onboard an aircraft for setting up a microcell within the aircraft which can co-operate with mobile terminals, e.g. mobile phones, provided by the passengers themselves and which can be used in exactly the same way as they would be used on the ground. Communications are exchanged with ground via a bearer system and the ground apparatus which co-operates with the onboard apparatus includes a network of bearer transceivers and an existing conventional mobile-phone network, with an interface between the two. Preferably the microcell is a GSM microcell and the bearer is a TFTS system, though alternative bearers may be employed, e.g., SATCOM and IRIDIUM. The communications arrangement enables a communications link to be established in either direction, from an air passenger to an ISDN/PSTN user or another mobile subscriber, or vice-versa. The arrangement allows low levels of power to be realised in the onboard mobile terminals, such that risk of interference with the aircraft's operations are minimal.



WO 00/76087 A1



**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**(48) Date of publication of this corrected version:**

13 September 2001

**(15) Information about Correction:**

see PCT Gazette No. 37/2001 of 13 September 2001, Section II



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification: <b>H04B 7/185</b>	<b>A1</b>	(11) International Publication Number: <b>WO 00/76087</b> (43) International Publication Date: 14 December 2000 (14.12.2000)
(21) International Application Number: PCT/GB00/02240 (22) International Filing Date: 08 June 2000 (08.06.2000) (30) Priority Data: 9913351.4 08 June 1999 (08.06.1999) GB (60) Parent Application or Grant BAE SYSTEMS PLC [/]; O. LITTLE, John, Ross [/]; O. SEVERWRIGHT, Anthony [/]; O. LITTLE, John, Ross [/]; O. SEVERWRIGHT, Anthony [/]; O. HOSTE, Colin, Francis ; O.	<b>Published</b>	
(54) Title: AIRCRAFT COMMUNICATION ARRANGEMENT DEFINING A RADIO FREQUENCY MICROCELL WITHIN THE AIRCRAFT (54) Titre: DISPOSITIF DE COMMUNICATIONS DESTINE AUX AVIONS, DEFINISSANT UNE MICROCELLULE RADIOFREQUENCE A BORD D'UN AVION		
(57) Abstract <p>In a communications arrangement, apparatus is provided onboard an aircraft for setting up a microcell within the aircraft which can co-operate with mobile terminals, e.g. mobile phones, provided by the passengers themselves and which can be used in exactly the same way as they would be used on the ground. Communications are exchanged with ground via a bearer system and the ground apparatus which co-operates with the onboard apparatus includes a network of bearer transceivers and an existing conventional mobile-phone network, with an interface between the two. Preferably the microcell is a GSM microcell and the bearer is a TFTS system, though alternative bearers may be employed, e.g., SATCOM and IRIDIUM. The communications arrangement enables a communications link to be established in either direction, from an air passenger to an ISDN/PSTN user or another mobile subscriber, or vice-versa. The arrangement allows low levels of power to be realised in the onboard mobile terminals, such that risk of interference with the aircraft's operations are minimal.</p> (57) Abrégé <p>L'invention concerne un dispositif de communications dans lequel est fourni un appareil situé à bord d'un avion et destiné à l'installation d'une microcellule dans l'avion, microcellule pouvant coopérer avec des terminaux mobiles, tels que des téléphones mobiles, appartenant aux passagers eux-mêmes, et ayant le même mode d'utilisation que sur terre. Des communications sont échangées avec la terre par l'intermédiaire d'un système support. L'appareil au sol, qui coopère avec l'appareil de bord, comprend un réseau d'émetteurs-récepteurs supports et un réseau de téléphonie mobile conventionnel existant, une interface reliant les deux. La microcellule est, de préférence, une microcellule GSM et le support est un système TFTS, bien que d'autres supports peuvent être utilisés, comme p. ex. SATCOM et IRIDIUM. Le dispositif de communications permet qu'une liaison de communications soit établie dans les deux directions, soit d'un passager aérien à un utilisateur ISDN/PSTN ou à un autre abonné mobile, ou inversement. Le dispositif permet d'obtenir de faibles niveaux de puissance dans les terminaux mobiles à bord de l'avion, de façon à réduire au maximum les risques d'interférence avec les commandes dudit avion.</p>		

(57) **Abstract:** In a communications arrangement, apparatus is provided onboard an aircraft for setting up a microcell within the aircraft which can co-operate with mobile terminals, e.g. mobile phones, provided by the passengers themselves and which can be used in exactly the same way as they would be used on the ground. Communications are exchanged with ground via a bearer system and the ground apparatus which co-operates with the onboard apparatus includes a network of bearer transceivers and an existing conventional mobile-phone network, with an interface between the two. Preferably the microcell is a GSM microcell and the bearer is a TFTP system, though alternative bearers may be employed, e.g., SATCOM and IRIDIUM. The communications arrangement enables a communications link to be established in either direction, from an air passenger to an ISDN/PSTN user or another mobile subscriber, or vice-versa. The arrangement allows low levels of power to be realised in the onboard mobile terminals, such that risk of interference with the aircraft's operations are minimal.

**WO 00/76087 A1**

---



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Description**

5

10

15

20

25

30

35

40

45

50

55

AIRCRAFT COMMUNICATION ARRANGEMENT DEFINING A RADIO FREQUENCY MICROCELL  
WITHIN THE AIRCRAFT

The invention relates to a communications arrangement enabling the occupants of an aircraft to communicate with other parties over a radio link.

Arrangements are already known for establishing telephone communication between a passenger on an aircraft and a ground-based party, two such arrangements being a hard-wired system and a cordless system, outlines of which are shown in Figures 1 and 2, respectively.

The hard-wired system comprises a number of phones 11 connected by respective electric cables 12 to a central digital exchange 13 (a CTU) on board the aircraft. The exchange sets up a communications link to ground through a bearer 14, such as a TFTS (Terrestrial Flight Telecommunications Service) unit, which co-operates via antennas 15, 16 with a series of, e.g. TFTS, ground stations (GS) 17 forming a network on the ground. The network is large enough to cover a suitably broad area for the capturing of signals from an overflying aircraft and in practice may comprise GS's along a flight path and also at individual airports. A TFTS ground switching centre (GSC) 18, of which there may be more than one (see Figure 3), controls the operating parameters of the GS's, e.g. their frequency of operation and transmission power, and also takes note of which TFTS GS is being used at any particular time by a particular aircraft and manages the establishment and clearing of telephone calls. Communications are routed via the TFTS GSC 18 to a ground-based communications network (not shown) such as a PSTN (Public Switched Telephone

Network) or ISDN (Integrated Services Digital Network), these networks terminating in the called party once a link has been established.

The cordless system (Figure 2) makes use of a number of cordless phones 21 communicating with a central onboard satellite unit 23 (e.g. of the type known as CT2), this unit as in the hard-wired case being connected to a radio bearer 24, such as a TFTS transceiver, and thence via a radio link to corresponding ground-based equipment - TFTS transceiver stations 27 and ground switching centre 28 - again ultimately terminating in the called party once a ground-based link has been completed through the ISDN or PSTN network.

Both systems have a number of drawbacks: firstly, the airline operator concerned has to provide dedicated phones inside the aircraft, which clearly incurs a not insignificant cost (bearing in mind also the possibility of theft by unscrupulous passengers); secondly, and more importantly, a communications link can only be established in one direction, namely from the onboard passenger down toward ground. It has not up till now been practicable to establish a link in the reverse direction. There are a number of reasons for this, the most significant being the small window of opportunity for contacting a passenger successfully on a short flight. A third drawback is the fact that the user of the system is forced to use a strange instrument which he, in the first place, might not be familiar with and, in the second place, might be wary of using from a hygiene point of view.

In accordance with a first aspect of the present invention there is provided an aircraft communications apparatus for establishing a communications link between a



party on an aircraft and a party external to the aircraft, comprising a means for defining a radio-frequency microcell within the aircraft, the cell-defining means being functional, in use, in co-operation with a mobile station employed by said party on the aircraft.

Advantageously, the cell-defining means may be configured to operate under the same format as a ground mobile network system in association with which the mobile station is configured to operate.

The cell-defining means may comprise a base station subsystem and one or more antennas connected to the base station subsystem. The antennas may be distributed around an interior space of the aircraft.

The apparatus may include a bearer transceiver means connected to the base station subsystem for the establishing of said link, the two being interconnected by a protocol-conversion means.

The base station subsystem may comprise a base station controller and a base station transceiver. The base station subsystem may be operable at more than one broadcast frequency.

The apparatus may comprise also a power monitor connected to the defining means for the monitoring of the level of power radiated by the mobile stations and for the switching off of the mobile stations when the level exceeds a given value.

An aeronautical gateway switching device may be provided for the interfacing of signals from the cell-defining means with a mobile communications network and/or a public switched telephone network and/or an integrated services digital network. The

5

4

10

aeronautical gateway switching device may interface said signals by way of a ground-based bearer apparatus which, in use, communicates with the on-board bearer transceiver means.

15

A further protocol conversion means may be provided for the interfacing of the gateway switching device with the ground-based bearer apparatus.

20

In accordance with a second aspect of the present invention there is provided a communications arrangement for the establishing of a communications link between an occupant of an aircraft and another party, comprising:

25

- in an aircraft, a microcell-defining means configured in accordance with a given mobile-communications format for co-operation with one or more onboard mobile terminals likewise configured to operate under the given format, and a first bearer means connected to the cell-defining means for establishing a communications link with ground, and

30

35

- on the ground, a second bearer means for communicating with the first bearer means, a mobile-communications network configured according to the given format, and a gateway switching device connected to interface the second bearer means with the mobile-communications network and with a public switched telephone network and/or an integrated services digital network.

40

45

The cell-defining means and the mobile communications network may operate under the GSM format and the bearer system may be one of a group comprising TFTS, SATCOM, NATS and IRIDIUM.

50

55

5

5

10

An embodiment of the invention will now be described with the aid of the drawings, of which:

15

Figure 1 is a schematic block diagram of a hard-wired communications arrangement employed in aircraft for air-to-ground communication;

5 Figure 2 is a schematic block diagram of a cordless-phone communications arrangement employed in aircraft for air-to-ground communication, and

20

Figure 3 is a block schematic diagram of a communications arrangement according to the present invention and employing an on-board GSM microcell in conjunction with a TSTS bearer.

25

10 Turning to Figure 3 now, there is introduced into the aircraft an apparatus comprising a GSM (Global System for Mobile communications) base station subsystem (BSS) 31 and a protocol converter 32. The BSS 31 consists, conventionally, of a base transceiver station (BTS) 33 and a base station controller (BSC) 34. The BTS 33 feeds  
30 one or more antennas 35 which are mounted at suitable locations around the aircraft interior, thereby defining a microcell. The apparatus is advantageously realised as an integral unit comprising a chassis, a power supply unit (PSU) and the protocol converter, though other mechanical arrangements are possible. Readily available BTS and BSC equipment may be employed in these positions, but may well have to be  
40 modified to withstand the aircraft environment, which is more hostile than the more usual ground-based environment, for example in terms of the vibration to which it may  
45 be exposed during flight. In addition, the PSU part of the apparatus will have to be able

40

45

20

50

55

5

6

10

to provide the normal BTS and BSC voltage supplies from the conventionally differing aircraft supplies.

15

The protocol converter 32 is connected in turn to a bearer unit 36, typically TFTS, which radiates via an antenna 37 communication signals at an appropriate frequency, e.g. 1800 MHz, to ground apparatus which will be described shortly. The converter 32 performs the function of changing the format of the signals leaving/entering the BSC on line 35 into a format which the TFTS can accept. More specifically, the interface between the BSC 34 and the aeronautical GMSC 70 is a so-called "A" interface, while that between the converter and the TFTS unit is an interface conforming to ETSI ETS 300326 and ETS 300752. The protocol converter makes the necessary adjustments to the messages to allow transmission through the TFTS bearer. (Since the interface between the phones and the BTS is the usual Um interface, while that between the BTS and the BSC is the conventional Abis interface, no special protocol converter is required in those positions).

20

25

30

35

Forming part of the ground-based equipment, and serving to communicate with the TFTS unit 36 via their own antennas 38, are a number of TFTS ground stations (GS) 39 which form, along with a TFTS ground switching centre (GSC) 40, a TFTS network as described earlier in connection with the known air-to-ground communications arrangements.

40

45

The communication signals passing through the TFTS GSC 40 are routed via an equipment (not shown) providing some of the functionality of a GSM MSC through to a conventional GSM network 50 comprising a number of network subsystems NSS 51

50

55

and a number of base station subsystems BSS 52. The network subsystems 51 connect to a common gateway mobile switching centre 53 which links up with the PSTN (Public Switched Telephone) or ISDN (Integrated Services Digital) networks.

The BSS's 52, of which only one is shown, comprise the same equipment functionality as the BSS 31 in the aircraft, namely a BSC 54 and a BTS 55 terminating in a number of antennas 56. In practice there may be more than one BTS served by the BSC 54, each feeding more than one antenna 56. The area covered by a single BTS defines a "cell" and the area covered by a number of BTS's under the control of the BSC 54 defines a "location area" (LA).

Each NSS 51 may be taken to comprise a mobile switching centre (MSC) 60, including the functionality of a home location register (HLR) 61 and a visitor location register (VLR) 62, an authentication centre (AUC) 63 and an equipment identity register (EIR) 64. The function of these is as described in the GSM standards.

Forming a link between the existing GSM network 51, 52, 53 and the TFTS network 39, 40 is an aeronautical gateway mobile switching centre (GMSC) 70 similar to the network GMSC 53. The GMSC 70 is associated with its own VLR 71, authentication centre (AUC) 72 and equipment identity register (EIR) 73 and is connected to the PSTN/ISDN networks. In addition, since the GMSC employs the same "A" interface as that of the on-board BSC 34, a further protocol converter 74 similar to the on-board converter 32 is included to interface the GMSC 70 to the TFTS GSC 40.

5  
10 The operation of this embodiment of the communications system according to the invention will now be described.

15 Although the system, as described, will support telephone calls initiated both from the aircraft and from the ground, for the purpose of illustration it is first of all  
5 assumed that a fixed ground-based caller, F, wishes to contact a mobile-phone carrying passenger, M, on board the aircraft containing the BSS equipment 31. It should first  
20 be appreciated that M is assumed to be "registered" with a particular cellular operator (e.g. Cellnet or Vodafone in the UK) and to have the "international roaming" facility  
25 enabled, and his details are contained in a particular "home" location register (HLR) associated with a particular "home" MSC, e.g. the HLR 61 and MSC 60 in Figure 3.  
30 The HLR will contain all the permanent and semi-permanent data peculiar to M, including his service profile (which services he has subscribed to), his international mobile subscriber identity (IMSI), which is his unique identifier on the network, his  
35 mobile station roaming number (MSRN), which defines his current location, and his activity status, which includes a log of his calls, their duration and cost. In addition,  
15 M has a mobile subscriber ISDN number (MSISDN) which is the number others dial to reach him.  
40

45 When M enters the aircraft, if his mobile phone is switched on it will continuously monitor the broadcast control channel (BCCH) radiated by the BTS 33  
20 and will make itself known to the ground-based system periodically (e.g. by default every 15 minutes or so). Essential details on M which the system requires to know are  
50 contained in his SIM (Subscriber Identity Module), a variety of smart card which must

5

9

10

15

20

25

be inserted into the mobile phone if the latter is to function. These details include M's IMSI (unique subscriber identity) and his own secret key for authentication purposes and these are sent via the BSS 31 and the TSTS 36 to the TSTS network 39, 40 and thence to the GMSC 70, VLR 71, AUC 72 and EIR 73, where they are used to update the system on M's activity and whereabouts. In particular, the secret key is used in conjunction with a random number in a special algorithm to generate an output number both in the mobile phone and in the AUC. A match between these output numbers authenticates the user. In addition, an equipment number peculiar to M's phone is sent to the EIR where it is checked against a list of such numbers and its status verified. If M's phone is not "black-listed", M's call is further authenticated.

30

35

M's IMSI is used by the GMSC to check the services and area restrictions to which M may be subject and, if the service in question and the area in which M finds himself are not restricted, this together with the authentications just described enable M to place and receive calls in the aircraft in that particular location.

40

45

M's location as noted by the VLR 71 is relayed back to M's own HLR 61 in order to update the records held there. This record then acts as a central routing pointer for outside callers wishing to contact M. The VLR in practice sends an MSRN (roaming number) back to the HLR which identifies that VLR as the one through which M can currently be reached.

50

If F now dials M's MSISDN number in an attempt to reach M, a message related to F's call will go via the ISDN system to the gateway MSC 53 which then

55

5  
10 routes it to M's own HLR (in this case the illustrated HLR 61). The specific HLR is identified by the MSISDN itself.

15 The HLR 61 sends back to the GMSC 53 the roaming number (MSRN) which is used by the GMSC 53 to route the call to the VLR 71. This VLR now converts the  
5 MSRN to M's own TMSI (Temporary Mobile Subscriber Identity) which is sent via the TFTS network to the aircraft, where M's phone is caused to ring by way of the  
20 BTS 33. Thus a link is established between F and M and voice communication may take place between them. Equally, if the terminal used by M allows this (e.g. if his  
25 phone has an LCD screen which can display short messages or his terminal is a radio  
10 laptop), alphanumeric or data messages may be exchanged. This assumes that M has subscribed to, for example, the Short Message Service which mobile operators offer.

30 In order to be able to route the call request to the correct aircraft, TFTS manages the location of the aircraft in an entity called the Gateway Location Register (GLR) 75. This may be either a single entity which serves all the various GSC's in the  
35 TFTS system, or there may be several in the system, depending on the level of traffic. This maintains information related to the best route to reach all aircraft currently  
40 connected to the TFTS network. The GLR 75 automatically updates this information as the aircraft flies through the network, the aircraft to this end being arranged to  
45 transmit "location registration" messages whenever the airborne TFTS 36 decides that  
20 it is appropriate to change cell.

50 If, conversely, M wishes to place a call to F on the ground, he dials F's ISDN number (the HLR-code part of the MSISDN is not needed in this case) and is linked



to the aeronautical GMSC 70 via the particular TFTS GS 39 which is receiving his signal, and then from the GMSC 70 directly to F via the PSTN/ISDN system.

Where M wishes to call another mobile number, e.g. a subscriber M\*, he dials M\*'s MSISDN number and is routed, as in the last scenario, to the GMSC 70 which, analogous to the GMSC 53 in F's case, contacts F's own HLR and extracts therefrom F's latest MSRN (roaming number). The call is then routed through to M\*'s current MSC and VLR, the latter then converting this MSRN into M\*'s own TMSI (temporary subscriber number), this number being then used to page M\* through his current BSC and BTS.

Finally, a call from, say, M\* to M is achieved by M\* dialling M's MSISDN number, upon which his call is routed via his current BTS, BSC and MSC (not a gateway MSC this time, since M\* is already on the mobile network) to M's HLR 61 which passes back to M\*'s current MSC M's current roaming number (MSRN). M\* is thereby routed through to M's current VLR 71 which, again, converts that MSRN into M's current TMSI which is routed through the TFTS network to the GSM equipment onboard the aircraft, so that M is then paged.

The invention may even cater for calls made from one aircraft occupant to another occupant of the same aircraft, for example where the parties concerned are at opposite ends of the aircraft and/or where it is inconvenient for the calling party to leave his or her seat to visit the called party in person. For this reason, and other reasons relating to the efficiency of routing incoming calls, the invention also envisages

the inclusion of some MSC functionality within the airborne equipment, i.e. linked with the BSS 31 onboard the aircraft.

It is a feature of the present invention that the power radiated by each individual onboard mobile phone can be reduced to a very low level while still enabling reliable communication to take place. Helpful in this regard is the possibility of using more than one antenna in the single cell defined by the BTS 33 to cover the whole passenger area of the aircraft. This has two benefits: firstly, radiations that do emanate from the individual mobiles are of a strength which is very unlikely to interfere with the proper operation of the measuring and communications systems of the aircraft itself.

A second advantage of the ability to reduce power in the mobile phones is the reduced interference with ground equipment. Since an aircraft overflies the GSM network of masts, it may have a direct line of sight with quite a number of them so that the onboard GSM equipment could conceivably communicate with more than one on a particular channel. This would have the effect of taking up capacity on the system, which is clearly wasteful. Reduction of power, however, serves to mitigate this problem.

If it is felt, nevertheless, that there is likely to be a problem with leaking radiation from the phones themselves, and/or from the internal antennas, the inventors propose the attachment of a transparent, attenuating, plastic film to the inside of each window in the passenger compartment. Self-adhesive film would be easiest to install and would also be relatively inexpensive.

Returning to the matter of the reduction of power in the mobiles, it is common practice in GSM to arrange for the BSC and the mobiles it serves to operate at the lowest power level that will maintain an acceptable signal quality, yet also minimize co-channel interference and save power. In this invention, as in normal GSM practice, the onboard BSC 34 performs measurements on the power level on the different mobiles and adjusts their levels so that the power is approximately equal for each channel burst occupied by the respective mobiles, while at the same time minimising the overall power level as just mentioned.

In a particular realisation of the invention it is arranged for the BSC 34 to be able to shut the mobile phones off inside the aircraft.

A potential problem with the implementation of the invention is the fact that passengers may be carrying phones based on differing frequency standards. Thus, while the UK operators Cellnet and Vodaphone operate in the 900 MHz band, Orange and One-to-One in the UK operate in the 1800 MHz band and US networks commonly operate at 1900 MHz. In order to be able to accommodate these differences, the onboard BTS 33 is arranged to operate at more than one frequency, in particular 900 and 1800 MHz. These frequencies may be used either simultaneously or serially, depending on the economics involved. As regards unsupported mobiles, it is envisaged under the present invention that the frequencies of these phones will be monitored and, if power is detected on those frequencies either before takeoff or during flight, the crew will be alerted who will then request the passengers concerned to turn their mobiles off.

5  
10 In the unlikely event that a mobile phone malfunctions and radiates an  
unacceptably high level of power, even during standby, the monitoring facility just  
mentioned will detect this and likewise alert the crew. Since the phones only radiate  
15 periodically on standby, so that they can perform the short logon "burst" necessary to  
5 indicate their presence to the rest of the system, it is necessary that the monitoring  
facility be of the "staring" type, i.e. continuously active.  
20

In summary, then, what has just been described is an embodiment of an  
invention which allows aircraft passengers to take on board their normal mobile phones  
25 and use them in the way they would normally do to communicate with ground-based  
10 parties. The numbers they would dial would be no different from the numbers that  
would normally be dialled for those parties (including the international prefix).  
30 Similarly, ground-based parties may freely dial up parties who are temporarily in  
flight, again without any special provisions having to be made in the form of special  
35 numbers, etc. Thus the invention provides a communication system in which a ground-  
15 based calling party need not know that the called party is in the air, similarly a  
passenger in flight can call someone without having to consider whether that person is  
40 on land or is himself also in the air.

While the described embodiment has been based on the use of certain specific  
45 features, in particular an onboard GSM microcell and a TFTP bearer system, in  
20 practice the invention is not limited to these, but instead other mobile communications  
systems may be used, and likewise other bearers. As examples, other possible mobile  
50 systems are NADC (North American Digital Cellular), DCS (Digital Cellular System)

5

10

15

1800, PDC (Personal Digital Cellular), JDC (Japanese Digital Cellular) and PCS  
(Personal Communications Systems), while alternative bearers are SATCOM, NATS  
(North American Terrestrial Service), IRIDIUM, etc. Different bearers will require  
different interfacing with the mobile system on board the aircraft, cf. the protocol  
converters 32 and 74 in the GSM/TFTS case, and will need the provision of the  
function of the aeronautical GMSC 70.

20

25

30

35

40

45

50

55

Claims

5

10

15

20

25

30

35

40

45

50

55

**CLAIMS**

1. An aircraft communications apparatus for establishing a communications link between a party on an aircraft and a party external to the aircraft, comprising a means for defining a radio-frequency microcell within the aircraft, the cell-defining means being functional, in use, in co-operation with a mobile station employed by said party on the aircraft.
2. Communications apparatus as claimed in Claim 1, wherein the cell-defining means is configured to operate under the same format as a ground mobile network system in association with which the mobile station is configured to operate.
3. Communications apparatus as claimed in Claim 1 or Claim 2, wherein the cell-defining means comprises a base station subsystem and one or more antennas connected to the base station subsystem.
4. Communications apparatus as claimed in Claim 3, wherein the one or more antennas are distributed around an interior space of the aircraft.
5. Communications apparatus as claimed in Claim 3 or Claim 4, comprising a bearer transceiver means connected to the base station subsystem for the establishing of said link.

6. Communications apparatus as claimed in Claim 5, comprising a protocol-conversion means interconnecting the base station subsystem and the bearer transceiver means.

7. Communications apparatus as claimed in any one of Claims 3 to 6, wherein the base station subsystem comprises a base station controller and a base station transceiver.

8. Communications apparatus as claimed in any one of Claims 3 to 7, wherein the base station subsystem is operable at more than one broadcast frequency.

9. Communications apparatus as claimed in any one of the preceding claims, comprising a power monitor connected to the defining means for the monitoring of the level of power radiated by the mobile stations and for the switching off of the mobile stations when the level exceeds a given value.

10. Communications apparatus as claimed in any one of the preceding claims, wherein the cell-defining means is a GSM cell-defining means.

11. Communications apparatus as claimed in any one of the preceding claims, wherein the bearer transceiver means is one of a group comprising a TETS, a SATCOM, a NATS and an IRIDIUM bearer transceiver means.



5  
10  
15  
12. A communications apparatus as claimed in any one of Claims 1 to 9, comprising an aeronautical gateway switching device for the interfacing of signals from the cell-defining means with a mobile communications network and/or a public switched telephone network and/or an integrated services digital network.

20  
25  
5 13. Communications apparatus as claimed in Claim 12, wherein the aeronautical gateway switching device interfaces said signals by way of a ground-based bearer apparatus which, in use, communicates with the on-board bearer transceiver means.

30  
10 14. Communications apparatus as claimed in Claim 13, comprising a further protocol conversion means for the interfacing of the gateway switching device with the ground-based bearer apparatus.

35  
40  
15. Communications apparatus as claimed in Claim 13 or Claim 14, wherein the cell-defining means and the mobile communications network are a GSM cell-defining means and a GSM mobile communications network, respectively.

45  
50  
15 16. Communications apparatus as claimed in any one of Claims 13 to 15, wherein the onboard bearer transceiver means and the ground-based bearer apparatus are a TFTS bearer transceiver means and a TFTS ground-based bearer apparatus, respectively.

5  
10 17. A communications arrangement for the establishing of a communications link between an occupant of an aircraft and another party, comprising:

15 - in an aircraft, a microcell-defining means configured in accordance with a given mobile-communications format for co-operation with one or more onboard  
5 mobile terminals likewise configured to operate under the given format, and a first  
20 bearer means connected to the cell-defining means for establishing a communications link with ground, and

25 - on the ground, a second bearer means for communicating with the first bearer means, a mobile-communications network configured according to the given format,  
10 and a gateway switching device connected to interface the second bearer means with the mobile-communications network and with a public switched telephone network  
30 and/or an integrated services digital network.

35 18. Communications arrangement as claimed in Claim 17, wherein the mobile-communications format is GSM.

40 19. Communications arrangement as claimed in Claim 17 or Claim 18, wherein the first and second bearer means are one of a group comprising a TFTS, a SATCOM, a  
45 NATS and an IRIDIUM bearer means.

50 20. Communications arrangement as shown in, or as hereinbefore described with reference to, Figure 3 of the drawings.

1/2

Fig.1.

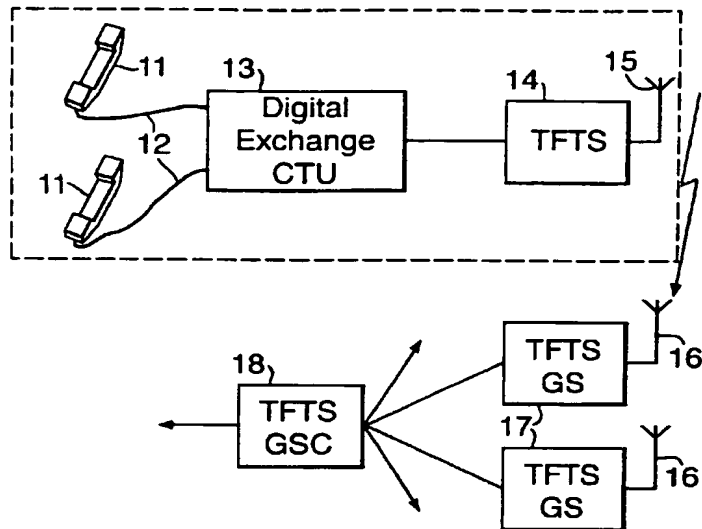
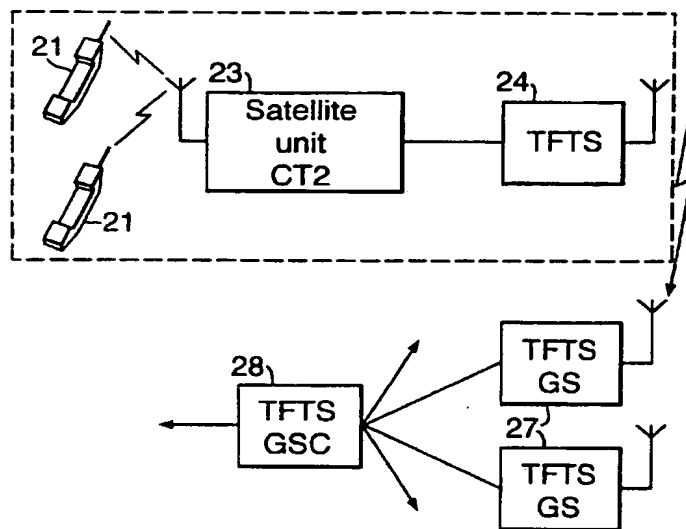
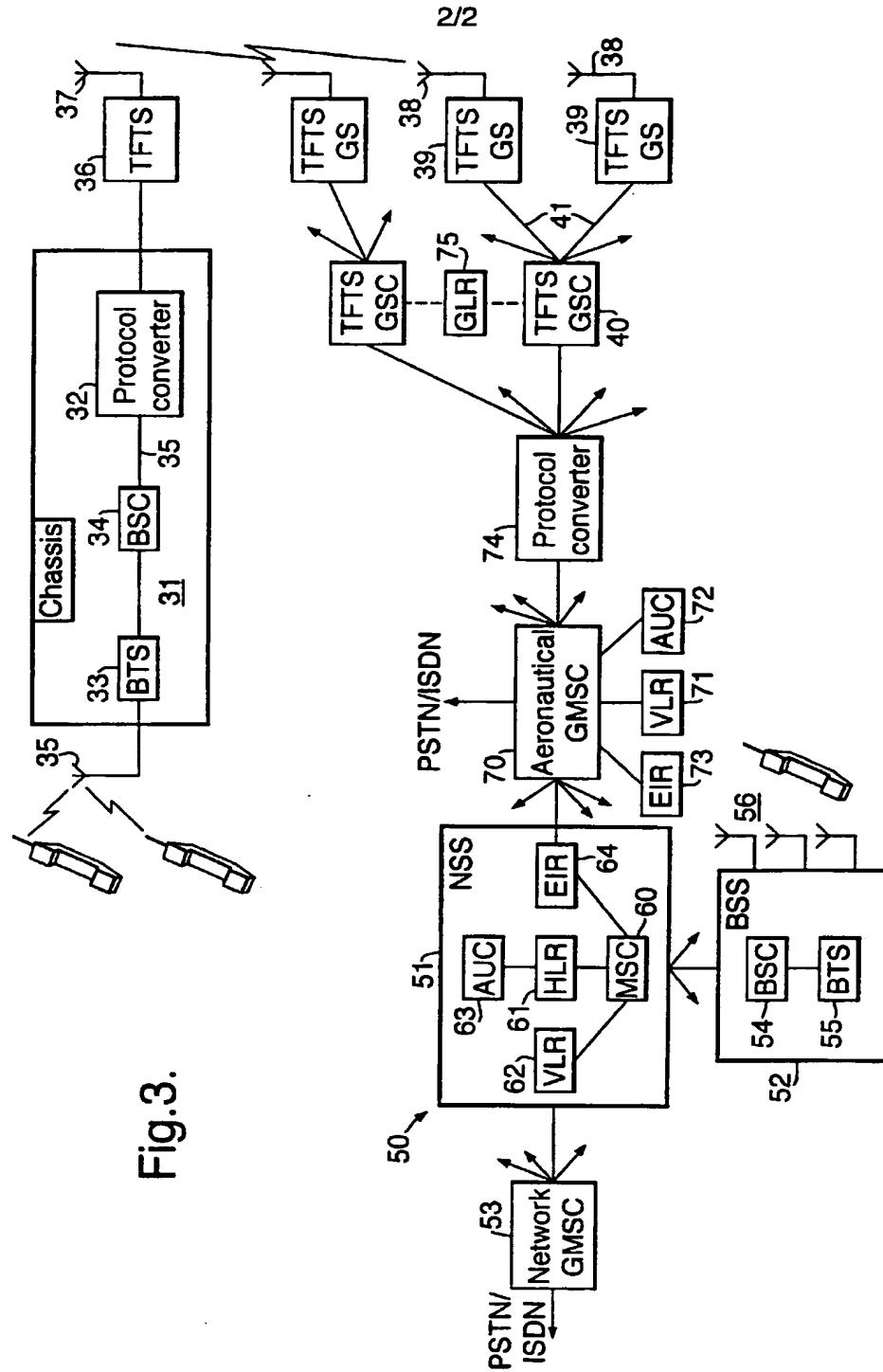


Fig.2.





**Fig. 3.**

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02240

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 H04B7/185

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 197 48 899 A (ROHDE & SCHWARZ) 6 May 1999 (1999-05-06)  column 1, line 1 -column 2, line 48	1-7, 9-11, 15-20
X	WO 94 28684 A (PALMGREN CHRISTER ;NORDICTEL AB (SE); OERNEHOLM FLEMMING (SE)) 8 December 1994 (1994-12-08) claims 1-10; figures 1,2	1-7,10, 11,15-20
X	WO 96 02094 A (QUALCOMM INC) 25 January 1996 (1996-01-25) claims 1-5; figures 1-4	1-7,17
A	WO 99 22465 A (AIRCELL INC) 6 May 1999 (1999-05-06) page 4, line 28 -page 7, line 12	1-20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

6 October 2000

Date of mailing of the international search report

20/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patendaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Bischof, J-L

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/02240

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 19748899	A	06-05-1999	EP 0915577 A	12-05-1999
WO 9428684	A	08-12-1994	SE 500443 C	27-06-1994
			AU 6901994 A	20-12-1994
			SE 9301784 A	27-06-1994
WO 9602094	A	25-01-1996	US 5559865 A	24-09-1996
			AU 2967295 A	09-02-1996
WO 9922465	A	06-05-1999	US 6108539 A	22-08-2000
			AU 9600798 A	17-05-1999
			EP 1027774 A	16-08-2000